

Appl. No. 10/710,438
Amdt. dated April 25, 2006
Reply to Office action of January 25, 2006

REMARKS

Amendments to the specification

Paragraph [0044] is amended to correct a grammatical error. No new matter is entered.

5 Amendments to the claims

Claims 3 and 4 are amended to be dependent on claim 2 because claim 2 introduces the variable N referenced in claims 3 and 4. Similarly, claims 13 and 14 are amended to be dependent on claim 12 because claim 12 introduces the variable N referenced in claims 13 and 14. No new matter is entered.

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Claims 1-3, 5-7, 11-13, and 15-17 are rejected under 35 USC 103a as being unpatentable over Calafato et al. (US 6,133,718)

15 In rejecting the underlying claims of the present invention, the Examiner stated in the current official action, "It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the reference generator of Calafato et al. by utilizing a signal to voltage converter, such as a resistor, to generate a reference voltage from the reference current since this is nothing more than basic electrical engineering utilizing the relationship of current through a resistor to the voltage across the resistor, $V=IR$." (Office action mailed 01/25/2006, section 2)

20 Applicant asserts that the above statement by the Examiner would not justify the obviousness allegation because Calafato et al. actually teach against such an implementation or modification. In particular, the circuit and related teachings of Calafato et al. are directed at a "Temperature-stable Current Generation" (see title of Calafato et al.). To this end, Calafato et al. disclose a current generator in Fig.7. Referring to Fig.7, as stated in col 3, lines 20-30,
25 "the reference number 10 designates current generator 10 which generates a current that is based on the difference in the activation thresholds of transistors of the enhancement and native types, as shown in Fig.1, while the reference number 11 designates current generator

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11 which generates a current that is based on the thermal voltage, as shown in Fig.2. The block designated by the reference numeral 12 provides a sum of the currents emitted by the current generators 10 and 11 in order to output a reference current I_{ref} which is highly temperature-stable."

5 Applicant points out that according to the teachings of Calafato et al., it is in fact not a simple application of basic electrical engineering utilizing the relationship of current through a resistor to the voltage across the resistor ($V=IR$) to convert the highly temperature-stable I_{ref} to "a compensated reference voltage according to the combined signal", as is claimed in claim 1 of the present invention. Indeed, Calafato et al. state in col 1, lines 46-50, "In all the
10 above-cited cases, the resulting current references vary with temperature, due to the fact that the resistance of the resistor and the reference voltage corresponding thereto vary according to this parameter." Additionally, Calafato et al. again stress how the thermal drift of resistors is very significant in col 2, lines 60-63, stating "...tends to have a very limited thermal drift in comparison with the thermal drift of the resistor 2, which is very high and accordingly
15 constitutes the predominant temperature dependent component for the current generator of Fig.1."

By considering at least the above cited disclosures of Calafato et al., applicant asserts that it would not be obvious to a person skilled in the art to modify the reference generator of Calafato et al. by utilizing a signal to voltage converter, such as a resistor, to generate a
20 compensated reference voltage from the temperature-stable reference current I_{ref} of Calafato et al. This is because the design and teachings of Calafato et al. are specifically directed at producing a temperature-stable current I_{ref} and no consideration of how to thereafter convert the current I_{ref} into a temperature-stable voltage is provided by Calafato et al. The application of basic electrical engineering techniques to include a suitable signal to voltage converter as
25 suggested by the Examiner is actually taught against by Calafato et al. because a signal to voltage converter such as a resistor would produce a voltage that is greatly temperature-unstable due to the large thermal drift of resistors. That is, simply adding a current to voltage converter such as a resistor to the design of the Calafato et al. would not

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produce a temperature compensated reference voltage without further invention process. Quite to the contrary, the implementation of simply adding a resistor to the circuit of Calafato et al. can only result in a highly temperature-dependent output voltage, and no reasonable expectation of success of temperature-compensated reference voltage generation, as
5 otherwise provided by the detailed description and required by the claims of the present invention, can be achieved from the modification suggested by the Examiner.

Accordingly, it is the Applicant's position that since Calatafo et al. does not provide the necessary suggestion or motivation to modify, but instead teaches away from such modification, and scarcely shows any reasonable expectation of success in so modifying, the
10 cited reference simply does not make obvious the present invention as claimed in claim 1. A similar argument also applies to independent claim 11. Reconsideration of claims 1 and 11 is respectfully requested. As claims 2-10, and 12-20 are dependent on claims 1 and 11, respectively, if claims 1 and 11 are found allowable, so too should their dependent claims. Further comments regarding the patentability of specific dependent claims are provided
15 below.

Claims 4 and 14 are rejected under 35 USC 103a as being unpatentable over Calafato et al (US 6,133,719)

The Examiner stated, "It would have been obvious to one of ordinary skill in the art at
20 the time of the invention to have modified the reference generator of Calafato et al. by utilizing at least 3 signal generators since it has been held that where the general conditions of the claim are disclosed in the cited and applied prior art, discovering the optimum or workable value of a result effective variable involves only routine skill in the art". (Office action mailed 01/25/2006, section 3)

25 Applicant firstly asserts that it would not be obvious to modify the reference generator of Calafato et al. by utilizing at least three signal generators because Calafato et al. specifically teach utilizing two current generators having different temperature gradients to thereby obtain a very stable current reference. In particular, as shown in Fig.7 and disclosed

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in col 3, lines 11-17, Calafato et al. state, "The current generator according to the present invention utilizes a linear combination of the currents supplied by the above-described current generators, i.e., by the current generator 10 of Fig.1 and by the current generator 11 of Fig.2, so as to compensate for the two different temperature gradients thereof. In this manner it has
5 been possible to obtain a very stable current reference." The two different temperature gradients having opposite slopes are illustrated by Calafato et al. in Fig.5 and Fig.6, respectively.

Applicant asserts that it would be not be obvious to a person skilled in the art to utilize three (or more) signal generators in the design of Calafato et al. because this would result in
10 more than two temperature gradients and therefore at least two of the temperature gradients would have slopes in the same direction. It is not obvious how two temperature gradients being in the same direction could be compensated utilizing the teachings of Calafato et al. That is, having more than two signal generators conflicts with the teachings of Calafato et al. because Calafato et al. specifically teach two current generators having different (i.e.,
15 opposite sloping) temperature gradients to compensate for each other and thereby obtain the stable current reference Iref.

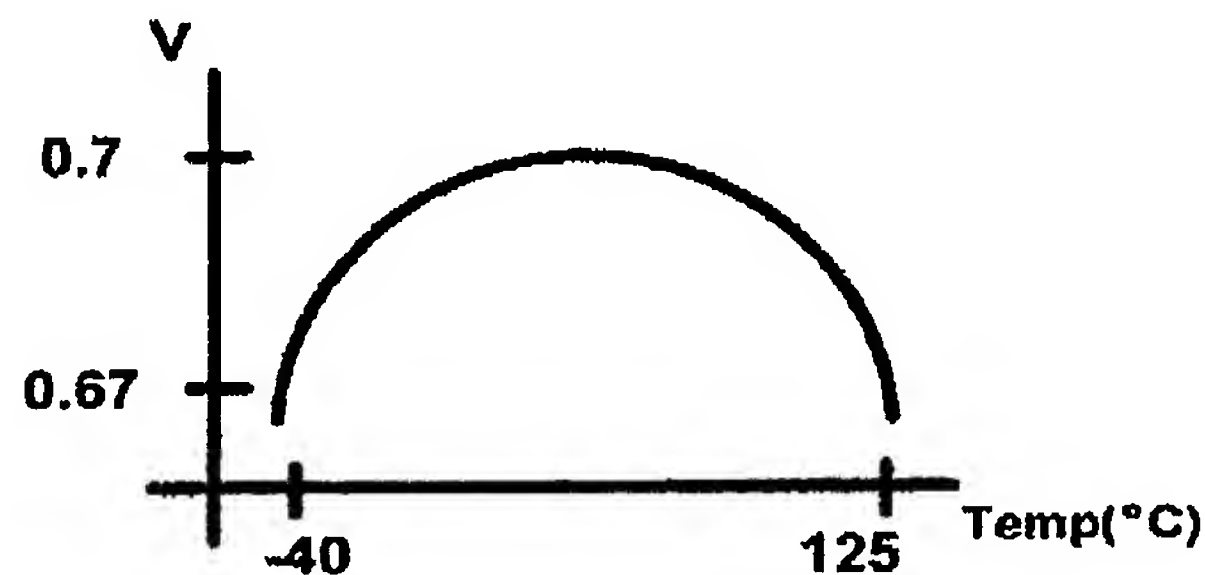
Additionally, Calafato et al. indeed discloses 2 current generators having different temperature gradients of opposite directions and discloses combining the two currents generated to result in a reference current Iref (Fig.5, Fig.6, also column 3, line 10-17), which
20 is nothing more than a conventional 1st order temperature compensation mechanism that the applicant has proved incomplete in earlier instances. Calafato et al. never further endeavors to expand its 1st order temperature compensation reference current generator to a more sophisticated, higher order temperature compensation circuitry, as does the present invention. The technology taught by Calafato et al. really serves to represent no more than the then
25 common implementation of a well-known 1st order temperature compensation reference current generator, and never sheds the slightest light on the possibility of compensating for temperature variation to a higher order. Serving as one of the supportive evidences, all of the un-referred-to prior art references in rejecting the present invention cited by the Examiner

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similarly discuss exclusively of a 1st order temperature compensation technology, and nothing beyond.

On the other hand, the present invention contrarily, using a 2nd order temperature compensation reference voltage generator with 3 signal generators, discloses a systematically expandable higher order temperature compensation (more specifically, Nth order compensation with N+1 signal generators) reference voltage generator, by introducing a mathematical representation of the resultant output reference voltage VREF and then a consistent methodology of determining coefficients, such as K1, K2, K3, ..., etc to be adopted in the design. Such a systematic and expandable methodology is nowhere to be found in Calafato et al.

Furthermore, when considering the achievable performance of the temperature compensation reference, the present invention also teaches a far more favorable technology than the prior art references, represented by Calafato et al. In Calafato et al, the reference current generator can achieve a 1st order temperature compensation characteristic such as shown below:

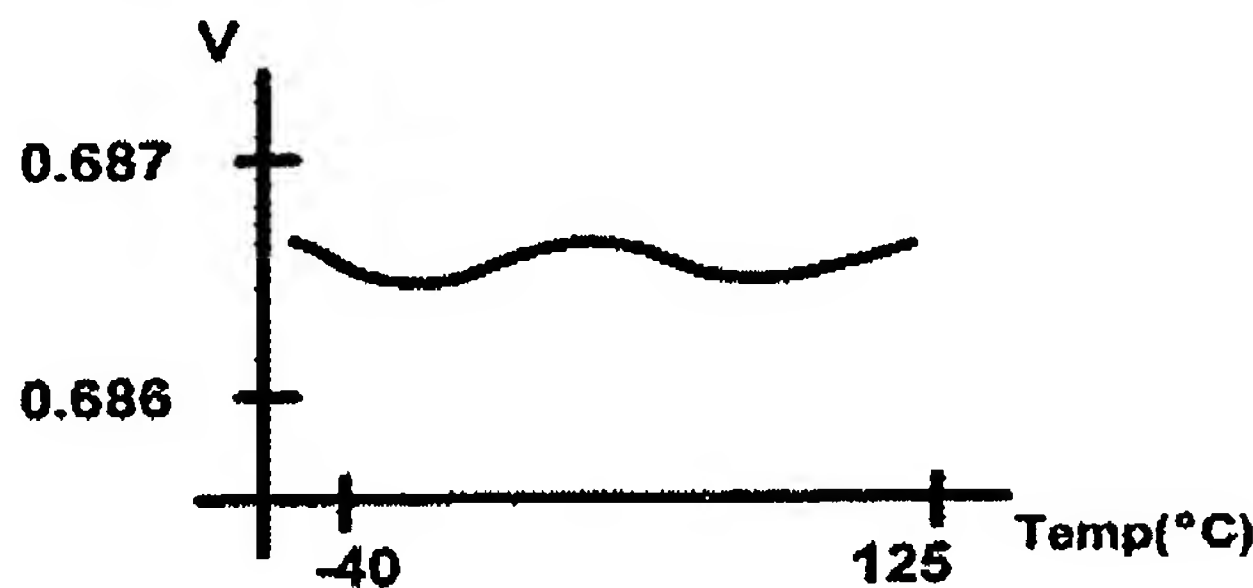


and a 4% variation in the temperature interval between -40 and 125°C can be observed. (Fig.8, Fig.9, also column 3, line 44-46) Such a characteristic is typical to 1st order temperature compensation mechanisms, and the other prior art references cited by the Examiner, though not explicitly shown, will have the same property, based on the understanding of a person of ordinary skill in the art.

However, the present invention with the ability to expand into higher order temperature

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compensation, can result in a far more stable characteristic as opposed to temperature variation. Taking the 2nd order temperature compensation reference voltage generator of the embodiment of the invention as an example, its temperature compensation characteristic will be understood by a person of ordinary skill in the art to show:



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and it is apparent that the fluctuation of the output reference voltage due to temperature variation is confined to within a more limited range, and therefore a more stable system. As a result, by using the systematic and expandable method taught by the present invention, even higher order temperature compensation reference voltage generator with even more finely manipulated and more stabilized temperature compensation result can be subsequently designed, while Calatafo et al. never satisfactorily shows such a possibility.

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For at least the above stated reasons, applicant asserts that claims 4 and 14 should be found allowable with respect Calafato et al. Reconsideration of claims 4 and 14 is respectfully requested.

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Claims 8-10 and 18-20 are rejected under 35 USC 103a as being unpatentable over Calafato et al (US 6,133,718)

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The Examiner stated, "It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified the reference generator of Calafato et al. by utilizing any old and known signal generator circuitry, such as that specifically recited by applicant, as the signal generators (10 and 11) since said artisan would be expected to utilize which ever old and known signal generator circuitry best suited the situation at hand." (Office

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action mailed 01/25/2006, section 4)

Applicant asserts it would not be obvious to one skilled in the art to modify the reference generator of Calafato et al. by utilizing the signal generator circuitry recited by the present invention because if each signal generator 10, 11 of Calafato et al. comprised the components
5 recited in claims 8-10 and 18-20 then the circuit of Calafato et al. would no longer generate a temperature-stable current I_{ref} . That is, the circuit of Calafato et al. would no longer function properly because the temperature gradient of signal generator 10 would no longer cancel with the temperature gradient of signal generator 11.

Calafato et al. specifically teach that the two signal generators 10 and 11 need to be of
10 different types. For example, as shown in Fig.7 and stated in col 3, lines 20-26, "The reference number 10 designates current generator 10 which generates a current that is based on the difference in the activation thresholds of transistors of the enhancement and native types, as shown in Fig.1, while the reference number 11 designates current generator 11 which generates a current that is based on the thermal voltage, as shown in Fig.2." This is in
15 contrast to the present invention as claimed in claims 8-10 and 18-20, in which each of the signal generators is of the same type and comprises the same components. That is, Calafato et al. teach two signal generators 10, 11 having different temperature gradients to cancel with each other, while the present invention claims 8-10 and 18-20 state that "each signal generator" comprises the same components. (i.e., comprising a first current source, a second
20 current source, a resistor, a transistor, and a control signal as claimed in claim 8, for example.)

Applicant therefore asserts that claims 8-10 and 18-20 should not be found unpatentable in view of Calafato et al. for at least the reason that the circuit design of Calafato et al. would clearly fail to operate properly if both signal generators 10, 11 were implemented using the circuit structure claimed for the each of the signal generators by the present invention in
25 claims 8-10 and 18-20. Reconsideration of claims 8-10 and 18-20 is respectfully requested.

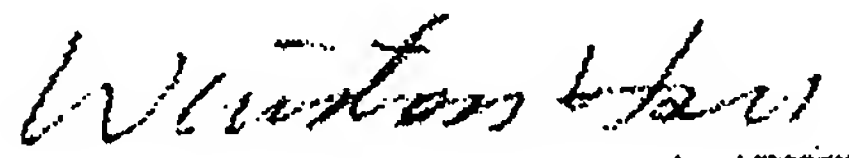
Newly Added Claim

Claim 21 has been newly added. Claim 21 incorporates the limitation of "signal to

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voltage generator" and the limitation of "N being integer equal to or larger than 2". No new matter is entered. Applicant asserts that new claim 21 should be considered allowable for at least the same reasons as set forth in the foregoing sections.

5 Sincerely yours,



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15 is 12 hours behind the Taiwan time, i.e. 9 AM in D.C. = 9 PM in Taiwan.)